Measurement of coupling and interstrip capacitances in silicon microstrip sensors for the CBM experiment at FAIR*

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The main component of the future CBM experiment [1] at FAIR (Darmstadt, Germany) [2] is the Silicon Tracking System [3]. It is going to be based on double-sided silicon strip sensors. Among the important characteristics of silicon strip sensors are the coupling (C_c) and the interstrip capacitances (C_{iImp}, C_{iStrip}), because they affect the signal amplitude [4, 5]. Measurement of these capacitances is therefore important both in the stage of detector prototyping and in the stage of series production for their quality assurance.

The coupling capacitance (C_c), is the capacitance between a metal strip ("Metalisation" in Fig. 1) and the implant underneath. C_{iImp} — is the total capacitance of an implant to the neighboring metal strips, and C_{iStrip} — is the total capacitance of a metal strip to the neighboring metal strips. The capacitances were measured with a QuadTech 7600 precision LCR meter. To determine the coupling capacitance the test voltage (0.5 V) was applied to the selected implant, and the current, induced on the metal strip above, was measured. To measure C_{iImp}, the test voltage was applied to an implant, the metal strip above the implant was grounded, and the current was picked from the neigboring metal strips (three on each side). For C_{iStrip} measurement the test voltage was applied to a metal strip, and the current was picked up from the neighboring metal strips (three on each side).

In the measurements of C_c and C_{iImp} the observed values decrease at high frequencies (example in Fig. 2) because the resistance of the implant (which is on the order of 100 kΩ/cm) becomes comparable to, or larger than the impedance of the measured capacitance, thus the test signal does not propagate along the whole implant length [5, 6]. Correct values for C_c and C_{iImp} are obtained only at low frequencies.

The obtained values (shown in the table below) were applied to estimate the expected signal amplitude [5]. The developed measurement techniques will be used for further characterization and quality assurance of the sensors.

Sensor, side	C_c, pF/cm	C_{iImp}, pF/cm	C_{iStrip}, pF/cm
CBM02, n	37.8 ± 0.5	1.0 ± 0.5	1.4 ± 0.5
CBM02, p	34.7 ± 0.5	1.4 ± 0.5	2.2 ± 0.5
CBM03′, p	17.2 ± 0.5	1.0 ± 0.5	1.5 ± 0.5

*Work supported by HIC4FAIR, HGS-HIRe, and H-QM Helmholtz research school

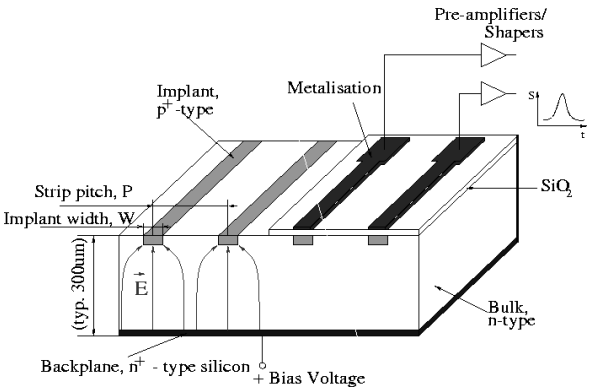

Figure 1: Schematic view of one side of a silicon microstrip sensor.

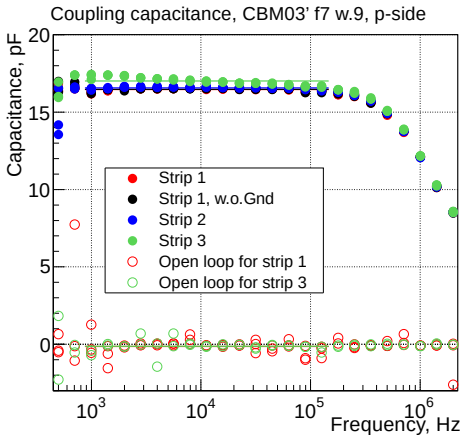

Figure 2: Coupling capacitance as a function of frequency in the CBM03' sensor.

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doi:10.15120/GR-2014-1-NQM-CBM-09